REMARKS

Claims 1-42 are pending. Claims 1, 21, 23 and 29 are independent claims. Applicant amends claims 1, 2, 8, 17, 18, 20, 21, 23 and 29, and cancels claim 19. Support for the amendments be can found throughout the specification. For example, support for the amendments to claims 1, 21, 23 and 29 can be found at page 7, lines 7-13; page 7, line 25 to page 8, line 11; and page 11, line 24 to page 13, line 6.

Applicant amends the specification to insert a missing, but fully apparent, unit of measure for the thickness TB of the blade 54. Accordingly, no new matter is entered with the foregoing amendments. The numbered paragraphs below correspond to the numbered paragraphs of the outstanding office action.

Rejections Under 35 U.S.C. § 102

1-2. The Examiner uses U.S. Patent No. 6,024,393 (Shamlou) to reject claims 1-4, 7-12, 29-37 and 39-40 as having been anticipated. Applicant respectfully traverses this rejection in view of the above amendments and the following remarks.

Claim 1, as amended, recites a system including "a robot including an articulated robotic arm; a processor for controlling the robotic arm; an end effector attached to a moveable end of the robotic arm, the end effector comprising a blade having a first end and a second end defining a critical plane, the blade having an active area configured to measure a distance between the substrate and the critical plane; and a mapping sensor disposed on the articulated robotic arm, the mapping sensor configured to measure to the position and orientation of the substrate within the carrier; and a passive gripper attached to the first end of the blade and an active gripper attached to the second end of the blade."

Claim 29, as amended, recites a "robotic end effector for holding a substrate, the end effector comprising: a mapping sensor configured to measure the position and orientation of the substrate; a blade having a first end and a second end defining a critical plane; an active area for sensing a distance between the substrate located along the blade and the critical plane; and a

passive gripper attached to the first end of the blade and an active gripper attached to the second end of the blade."

Shamlou is directed to a semiconductor substrate handling blade constructed from a "specialized material" which is non-metallic, preferably dielectric, exhibits the desired thermal stability and "must have also have a low-friction, non-abrasive surface which does not produce particulates when rubbed against the semiconductor device substrate construction to reduce particulate contamination." Shamlou at col. 4, lines 26-49. A vacuum is applied through channels machined into the upper surface 203 of bottom plate 202 of the handling blade 100 terminating in vacuum openings 118 for holding a semiconductor substrate to the upper surface. See Shamlou, col. 8, lines 34-46. One embodiment of Shamlou describes a substrate handling blade formed of "[a] single crystal structure ... or fused crystalline structure [which] can be used to provide [sic] a smooth, low-friction surface which is essentially void free." See col. 9, lines 26-30 of Shamlou.

Shamlou neither describes nor suggests an "end effector comprising a blade having a first end and a second end defining a critical plane, the blade having an active area configured to measure a distance between the substrate and the critical plane; and a mapping sensor disposed on the articulated robotic arm, the mapping sensor configured to measure to the position and orientation of the substrate within the carrier; and a passive gripper attached to the first end of the blade and an active gripper attached to the second end of the blade" as recited in claim 1. Nor does Shamlou describe or suggest a "robotic end effector for holding a substrate, the end effector comprising: a mapping sensor configured to measure the position and orientation of the substrate; a blade having a first end and a second end defining a critical plane; an active area for sensing a distance between the substrate located along the blade and the critical plane; and a passive gripper attached to the first end of the blade and an active gripper attached to the second end of the blade," as recited in claim 29.

In contrast, Shamlou discloses a capacitance sensor to indicate the presence of a substrate on the top surface of the handling blade, not the distance between the substrate and the end effector. See, for example, Shamlou at col. 12, lines 32-36. Further, the application of a vacuum from the handling blade of Shamlou is inapposite to handling a substrate subject to bowing or warping as described above and can result in permanent deformation and damage.

Specifically, "a capacitive sensor is used to indicate the presence of the semiconductor substrate (not shown) on the surface of the handling blade 10." Shamlou at col. 12, lines 32-37. According to Shamlou, "[w]hen there is no semiconductor device substrate on the top surface of the substrate handling blade, very little capacitance is measured by the capacitive sensor ... [w]hen there is a semiconductor device substrate on the top surface of the handling blade, the semiconductor device substrate forms one capacitor with the sensing layer and a second capacitor with the grounding layer." Shamlou at col. 12, lines 51-57.

Nowhere does Shamlou describe both a blade active area configured to measure a distance between the substrate and a critical plane defined by the end effector and a mapping sensor configured to measure the position and orientation of the substrate within the carrier. The system recited in claim 1 and the end effector recited in claim 29 are configured for handling substrates subject to bowing or warping which, in combination with other parameters, such as slot angle with respect to the critical plane, increase the system requirements for handling the substrate.

Accordingly, claim 1 is not anticipated by Shamlou. Claims 2-4 and 7-12 depend upon, and add further limitations to, claim 1. Accordingly, claims 2-4 and 7-12 are not anticipated by Shamlou. Claims 30-37 and 39-40 depend upon, and add further limitations to, claim 29. Accordingly, claims 30-37 and 39-40 are not anticipated by Shamlou.

3. The Examiner uses U.S. Patent No. 6,618,645 (Bacchi) to reject claims 21-25 and 27-28 as having been anticipated. Applicant respectfully traverses this rejection in view of the above amendments and the following remarks.

Claim 21, as amended, recites a "method for handling substrates held in a carrier, the method comprising: moving an end effector defining a critical plane across an edge of the substrates; measuring coordinate information of the substrates in the carrier with a mapping sensor; storing the coordinate information; sequentially indexing the robotic arm to the substrates in the carrier according to the stored coordinate information; measuring a distance between the substrate and the critical plane with a substrate sensor disposed on the end effector; and engaging the substrate with robotic arm.

Bacchi discloses a robotic arm end effector for transferring semiconductor wafers, the arm including sensors for determining positional data for the arm itself and the wafer to support "methods of rapidly and accurately placing and retrieving wafers from ... the wafer cassette [and thereby to] ... prevent accidental contact between the end effector and the wafers while effecting clean, secure gripping of the wafer. See Bacchi, Abstract.

Bacchi does not teach or suggest the recited features of claim 21. While Bacchi does disclose "wafer edge and elevation sensors that provide accurate wafer 12 positioning data relative to the end effector 10" (Bacchi, col. 7, lines 11-18), there is no disclosure of determining coordinate information of the substrates in the carrier, storing the coordinate information, sequentially indexing the robotic arm to the substrates in the carrier according the stored coordinate information, and measuring a distance to the substrate from the arm as recited in claim 21. Specifically, Bacchi describes light path sensors including a light source fiber 84 and a light receiver fiber 86 "that form a narrow light transmission pathway for detecting the presence or absence of periphery 18 of wafer 12." See Bacchi, col. 7, lines 18-35. Bacchi teaches detecting the presence, not the proximity, of the periphery of a wafer. Bacchi fails to disclose a method of measuring coordinate information of the substrates in the carrier with a mapping sensor and measuring a distance between the substrate and the critical plane with a substrate sensor disposed on the end effector. In contrast, the sensor in Bacchi operate such that an "[e]nd effector 10 is inserted in an X direction into cassette 14 between, for example, wafers 12 and 12B, until periphery 18 is sensed between at least one pair of light path openings 90." See Bacchi at col. 7, lines 60-63.

Claim 23, as amended, recites a "method for handling substrates held in a cassette, the method comprising: providing a robotic arm including a mapping sensor and an end effector including a substrate sensor, the end effector defining a critical plane; moving the mapping sensor proximate to the cassette and recording the mean vertical substrate locations; generating a pick table including mean vertical substrate location data; sequentially indexing the robotic arm according to the mean vertical substrate locations of the pick table; engaging the cassette with the end effector; measuring a distance between the substrate and the critical plane with a substrate sensor disposed on the end effector; verifying the substrate position with the substrate sensor; and capturing and removing the substrate from the cassette with the robotic arm."

As discussed above, Bacchi, does not describe or suggest moving a mapping sensor proximate to the cassette and recording the mean vertical substrate locations, sequentially indexing the robotic arm according to the mean vertical substrate locations of the pick table; and engaging the cassette with the end effector; measuring a distance between the substrate and the critical plane with a substrate sensor disposed on the end effector.

In contrast, Bacchi discloses a "procedure by which end effector 100 accesses a predetermine wafer from among closely space apart wafers in a cassette" by moving the end effector such that "light transmission pathways 202 intersects the bottom surface chord 200 of any wafer in cassette 14 and additionally, detects any obstruction projecting from the cassette 14." See Bacchi, col. 11, lines 24-28. Bacchi does describe other embodiments requiring the use of a "narrow light transmission pathway 244 for detecting the presence or absence of the periphery or bottom surface chord of a wafer." The end effector of Bacchi senses objects "that interrupt the light transmission pathway 244." See Bacchi, col. 23, lines 65 to col. 14, line 7.

Claims 22, 24, 25, 27 and 28 depend upon, and add further limitations to claims 21 and 23. Accordingly, claims 22, 24, 25, 27 and 28 are not anticipated by Bacchi.

Rejections Under 35 U.S.C. § 103

4-5. The Examiner uses Shamlou to reject claims 5-6 and 41-42 as having been obvious. Applicant respectfully traverses this rejection as follows.

Claims 5-6 depend upon, and add further limitations to, claim 1 and claims 41-42 depend upon and add further limitations to, claim 29. For the at least reasons discussed above with respect to claims 1-4, 7-12, 29-40, Shamlou fails to render obvious claims 5-6 and 41-42.

Specifically, Shamlou fails to disclose, teach or even suggest "an end effector comprising a blade having a first end and a second end defining a critical plane, the blade having an active area configured to measure a distance between the substrate and the critical plane; and a mapping sensor disposed on the articulated robotic arm, the mapping sensor configured to measure to the position and orientation of the substrate within the carrier; and a passive gripper attached to the first end of the blade and an active gripper attached to the second end of the blade" as recited in claim 1. Nor does Shamlou describe or suggest a "robotic end effector for holding a substrate, the end effector comprising: a mapping sensor configured to measure the position and orientation

of the substrate; a blade having a first end and a second end defining a critical plane; an active area for sensing a distance between the substrate located along the blade and the critical plane; and a passive gripper attached to the first end of the blade and an active gripper attached to the second end of the blade," as recited in claim 29.

Claims 5-6 depend from claim 1 and are allowable with it. Claims 41-42 depend from claim 29 and are allowable with it.

6. The Examiner uses Shamlou and Bacchi to reject claims 13-16 as having been obvious. Applicant respectfully traverses this rejection as follows.

Claims 13-16 depend upon, and add further limitation to, claim 1. Bacchi fails to cure the deficiencies of Shamlou. For at least the reasons discussed above with respect to claim 1, claims 13-16 are not rendered obvious by Shamlou and Bacchi.

Specifically, neither Shamlou nor Bacchi, considered alone or in combination, disclose, teach or even suggest "an end effector comprising a blade having a first end and a second end defining a critical plane, the blade having an active area configured to measure a distance between the substrate and the critical plane; and a mapping sensor disposed on the articulated robotic arm, the mapping sensor configured to measure to the position and orientation of the substrate within the carrier; and a passive gripper attached to the first end of the blade and an active gripper attached to the second end of the blade" as recited in claim 1.

Accordingly, Applicant respectfully requests that this rejection be withdrawn. Claims 13-16 depend from claim 1 and are allowable with it.

7. The Examiner uses Shamlou and U.S. Patent No. 6,164,894 (Cheng) to reject claims 17-20 as having been obvious. Applicant respectfully traverses this rejection as follows.

Claims 17-20 depends upon, and add further limitations to, claim 1. Cheng fails to cure the deficiencies of Shamlou. For at least the reasons discussed with respect to claim 1, claims 17-20 are not rendered obvious by Shamlou and Cheng.

Cheng discloses a wafer handling and testing apparatus including a "wafer handler and chuck having components for handling the wafer, mapping the wafer edge, centering the wafer, and testing the wafer in a low-cost system. See Cheng at col. 2, line 19-24. Although Cheng

does describe "mapping the wafer edge [and an] edge or the wafer is then mapped about a circumference of the wafer while the wafer is supported by the platform," Cheng fails to teach or suggest both a "blade having an active area configured to measure a distance between the substrate and the critical plane" and a "mapping sensor configured to measure to the position and orientation of the substrate within the carrier," as recited in claim 1, as amended.

Moreover, neither Shamlou nor Cheng disclose, teach or suggest the system of claim 1 further including a substrate prealigner and prealigner chuck, wherein the prealigner chuck is sized and configured to reduce rotational inertia, as recited in amended claim 17; a prealigner chuck including a plurality of embattlements for engaging an exclusion zone extending about 3 mm from the outside circumferential periphery of a substrate, as recited in amended claim 18; or a prealigner chuck comprises a plurality of holes to optimize the inertial properties and torque requirement of the prealigner chuck, as recited in amended claim 20.

As fully provided in the Specification, "[t]he prealigner chuck 90 is sized and configured to minimize contact with the surface of the substrate 24. For a substantially circular substrate 24, an exclusion zone extends about 3 mm from the outside circumferential periphery of the substrate 24 wherein handling contact is permissible. The prealigner chuck includes a plurality of projections or embattlements 92 for supporting the substrate 24 while it is rotated on the prealigner 40. The embattlements 92 can be sized and configured for asperity contact with the substrate 24. In one example, six embattlements 92 are uniformly located around the outside circumferential periphery of the substrate 24. In one example, the embattlements 92 are sized and configured to allow full engagement of the grippers 56, 58 of the end effector 42 with the substrate 24 at any orientation of the a prealigner chuck 90. The prealigner chuck 92 can include a plurality of holes 94 for optimizing the inertial properties and torque requirements of the chuck 92." See Specification at page. 9, line 30 to page 10, line 10.

Accordingly, Applicant respectfully requests that this rejection be withdrawn.

8. The Examiner uses Bacchi and Cheng to reject claim 26 as having been obvious. Applicant respectfully traverses this rejection as follows.

Claim 26 depends upon, and adds further limitation to, claim 23. Cheng fails to cure the deficiencies of Bacchi. For at least the reasons discussed with respect to claim 23, claim 26 is not rendered obvious by Bacchi and Cheng.

Specifically, neither Bacchi nor Cheng, considered alone or in combination, disclose, teach or even suggest a " method for handling substrates held in a cassette, the method comprising: providing a robotic arm including a mapping sensor and an end effector including a substrate sensor, the end effector defining a critical plane; moving the mapping sensor proximate to the cassette and recording the mean vertical substrate locations; generating a pick table including mean vertical substrate location data; sequentially indexing the robotic arm according to the mean vertical substrate locations of the pick table; engaging the cassette with the end effector; measuring a distance between the substrate and the critical plane with a substrate sensor disposed on the end effector; verifying the substrate position with the substrate sensor; and capturing and removing the substrate from the cassette with the robotic arm," as recited in amended claim 23.

Accordingly, Applicant respectfully requests that this rejection be withdrawn.

9. The Examiner uses Shamlou and U.S. Patent No. 6,040,585 (Hsiao) to reject claim 38 as having been obvious. Applicant respectfully traverses this rejection as follows.

Claim 38 depends upon, and adds further limitations to, claim 29. Hsiao fails to cure the deficiencies of Shamlou. For at least the reasons discussed with respect to claims 29, claim 38 is not rendered obvious by Shamlou and Hsiao.

Hsiao discloses a device and method for detecting the proper orientation of semiconductor wafer processed in a semiconductor wafer processing system using at least two laser beams and at least two receivers to sense when the wafer is not in a preselected desired position on the blade. However, Hsiao considered alone or in combination with Shamlou, does not disclose, teach or even suggest a "robotic end effector for holding a substrate, the end effector comprising a mapping sensor configured to measure the position and orientation of the substrate; a blade having a first end and a second end defining a critical plane; an active area for sensing a distance between the substrate located along the blade and the critical plane; and a

passive gripper attached to the first end of the blade and an active gripper attached to the second end of the blade," as recited in amended claim 29.

Accordingly, Applicant respectfully requests that this rejection be withdrawn.

It is believed that all of the pending claims have been addressed. However, the absence of a reply to a specific rejection, issue or comment does not signify agreement with or concession of that rejection, issue or comment. In addition, because the arguments made above may not be exhaustive, there may be reasons for patentability of any or all pending claims (or other claims) that have not been expressed. Finally, nothing in this paper should be construed as an intent to concede any issue with regard to any claim, except as specifically stated in this paper, and the amendment of any claim does not necessarily signify concession of unpatentability of the claim prior to its amendment.

CONCLUSION

Allowance of all claims is respectfully solicited. The undersigned remains available for consultation should the Examiner question the allowability of the claims as presently worded.

Enclosed is a check for the Petition for Extension of Time fee. Please apply any other charges or credits to deposit account 06-1050, referencing Attorney's Docket No. 05689-017001.

Respectfully submitted,

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David L. Schuler
Reg. No. 51,190

Fish & Richardson P.C.
Telephone: (617) 542-5070
Facsimile: (617) 542-8906